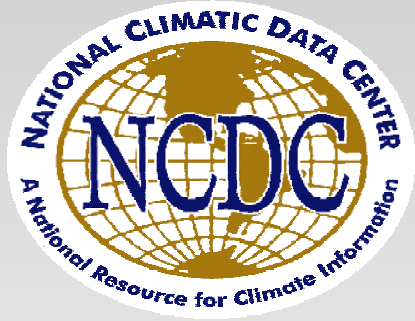


# The NOAA Operational Model Archive and Distribution System (NOMADS)



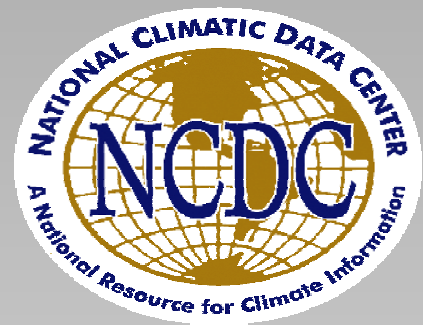
Glenn K. Rutledge  
Principal Investigator  
National Climatic Data Center

American Meteorological Society

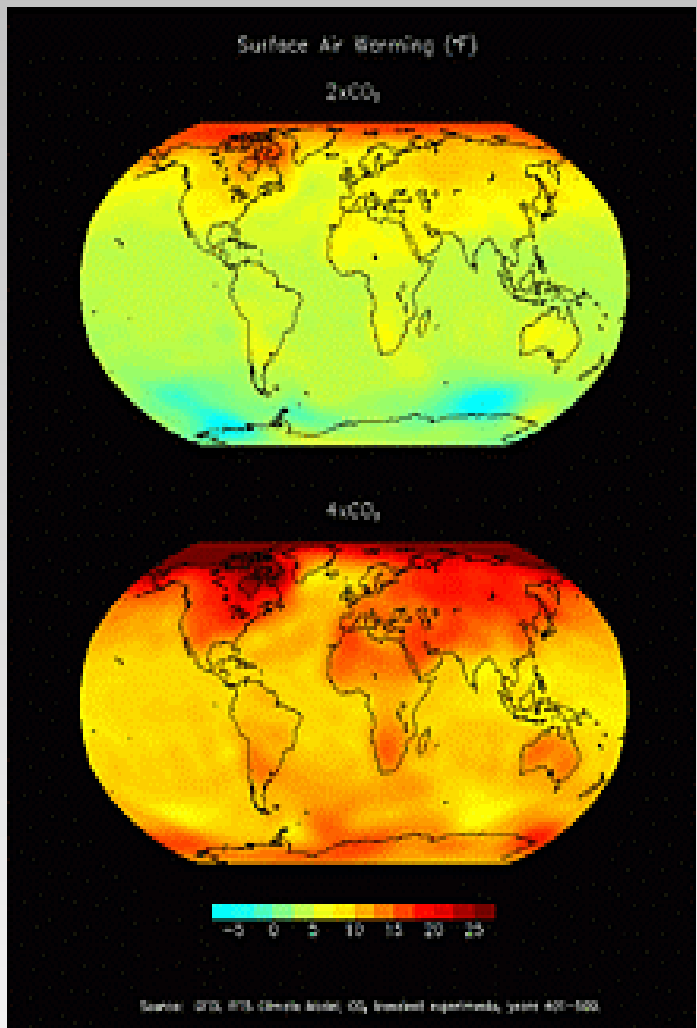
82<sup>nd</sup> Annual Meeting

Orlando, FL

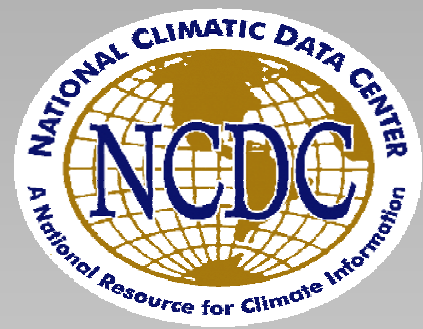
January 2002



# NOMADS: *Briefing Overview*

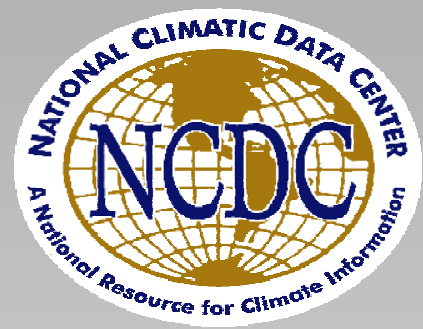


- Background
- What is it?
- Goals and Benefits
- NWP Access and Collaborators
- Network Topology
- DODS, GDS, and LAS
- Metadata, and Data Availability
- Schedule
- Data and Development Portals
- Team Members



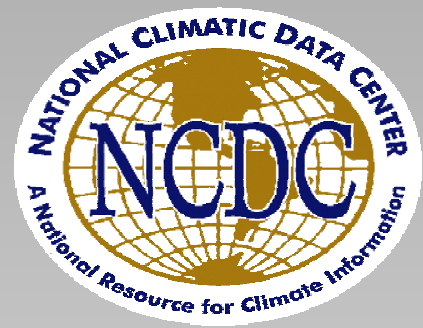
## NOMADS: *Background*

- Lack of access to weather and climate models initiated the grass roots NOMADS project.
- NOMADS has implemented a interface that allows distributed data sharing for climate and weather models.
- With these interfaces researchers focus on science, not issues with data receipt, format, and data set manipulation.

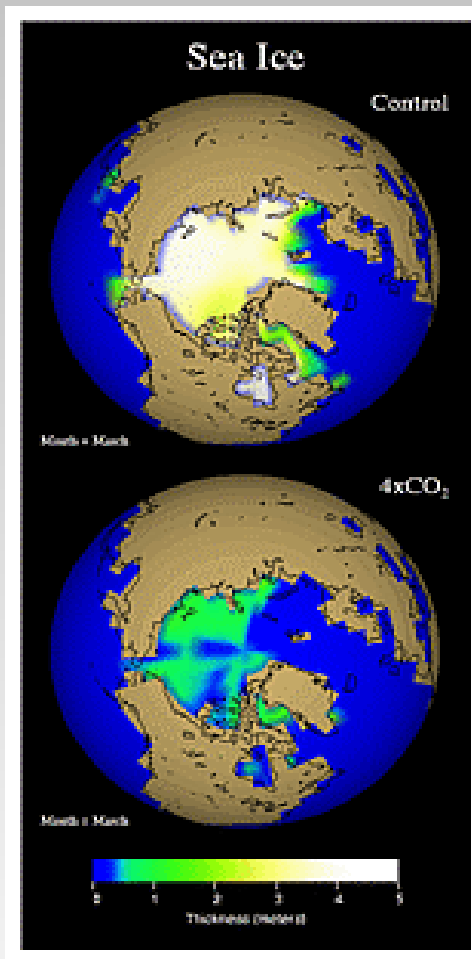


## NOMADS: *What is it?*

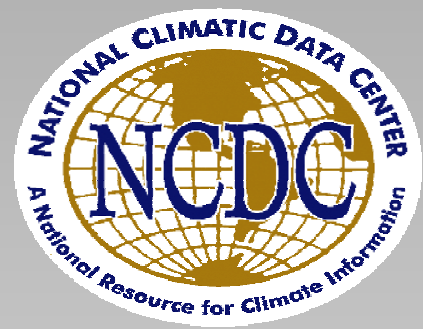
- **NOMADS** is a network of data servers using established and emerging technologies to access and integrate model and other data stored in distributed archives in different formats.
- **NOMADS** is already a major collaborative efforts that spans multiple Government agencies and academic institutions with a growth expectation to broadly serve the climate, weather, and ocean communities.



## NOMADS: *Goals*

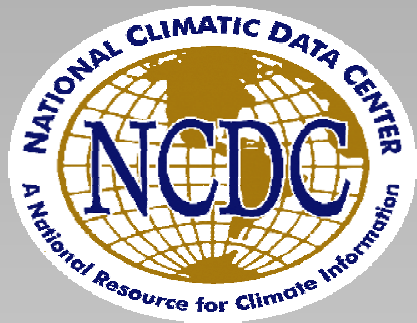


- The goals of NOMADS are to:
  - provide access to models
  - promote product development
  - foster research within the geo-science communities (ocean, weather, and climate) to study multiple earth systems using collections of distributed data
  - expand institutional participation



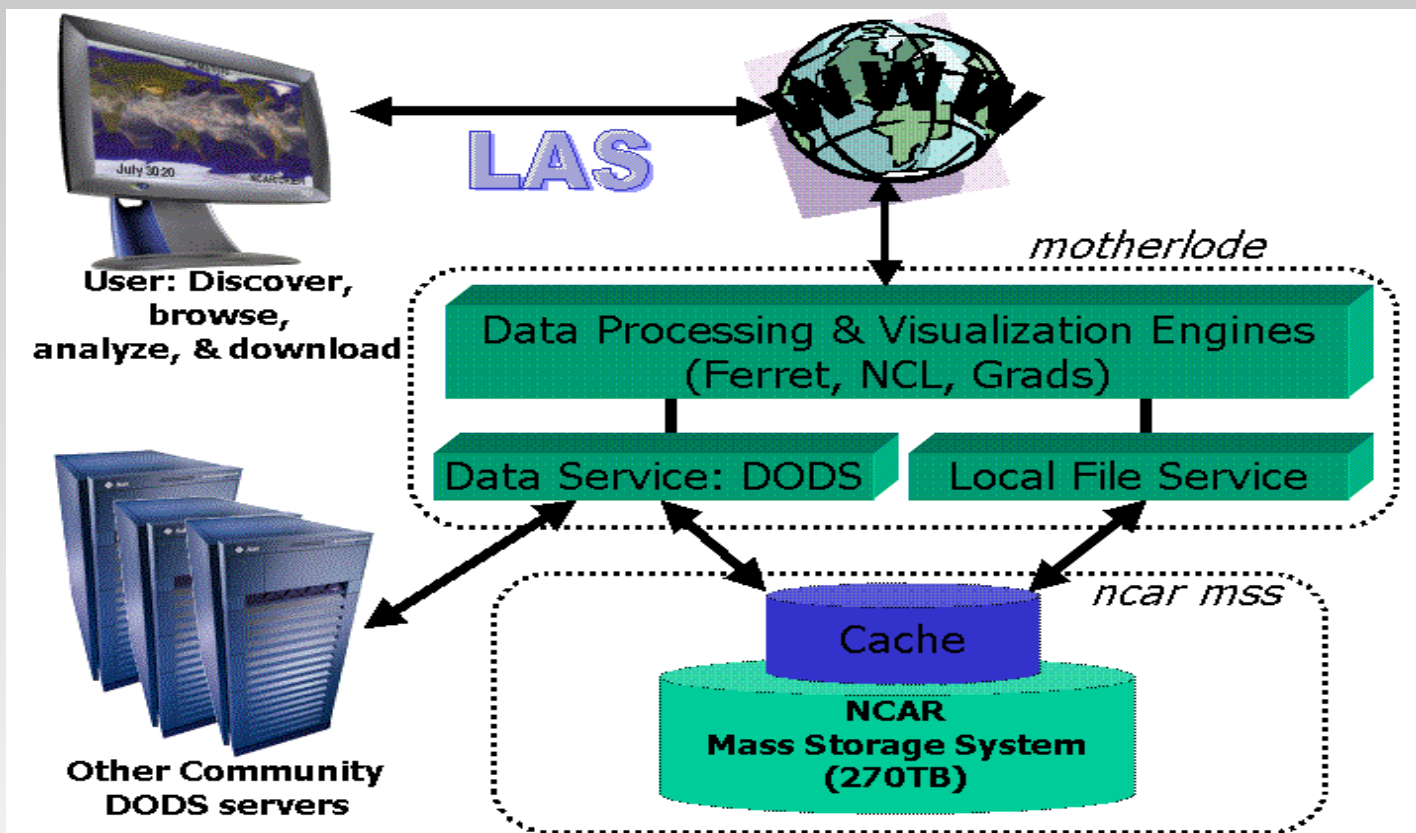
## NOMADS: *Benefits*

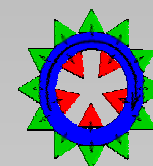
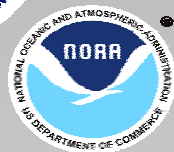
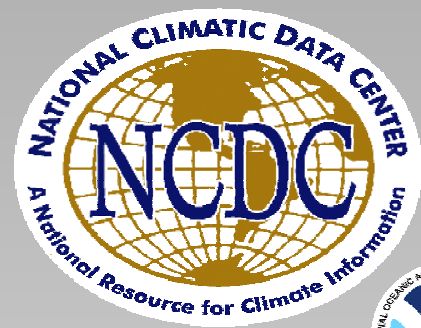
- Improved climate and weather assessments.
- Accurate estimates of climate variability and trends.
- Long-term protection of simulations and NWP analysis.
- Collaboration between GCM and NWP researchers.
- Climate modelers will have access to weather models and weather modelers will have access to climate models.
- NOMADS allows researchers to work in whatever format is most advantageous to them.



## NOMADS: *Benefits (cont.)*

"I downloaded five years of meso Eta 10m u/v components: Normally this 20,000 Mb job took hours. Using NOMADS technology it was just over 400Mb and took minutes"





## NOMADS: *Collaborators*

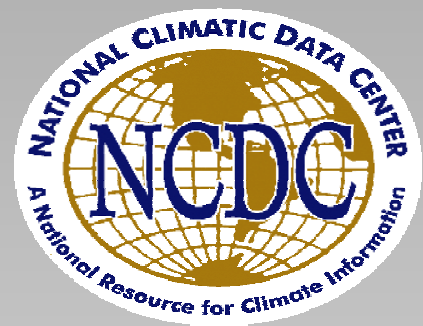
### Core Collaborators-

CDC  
COLA  
GFDL  
LLNL  
NCAR  
NCDC  
NCEP  
PMEL  
Unidata

### Participating Collaborators-

FSL  
George Mason U.  
NASA/GCMD  
NASA/SI-ESIP (GMU)  
NSSL w/UW/SSEC  
NWS/COMET  
NWS/HQ  
U. Of Alabama, Huntsville  
U. of Washington





## NOMADS: *Software Development*

### ➤ **PMEL:**

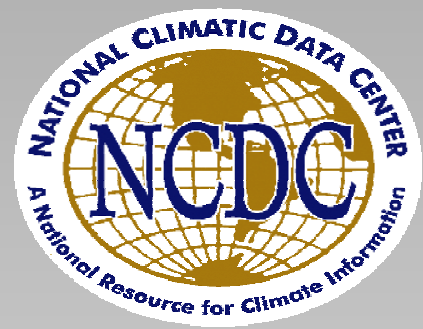
NOAA's Pacific Marine Environmental Laboratory developed Live Access Server (LAS) and Ferret.

### ➤ **COLA:**

The Center for Ocean-Land-Atmospheric Studies developed the GrADS-DODS Server (GDS) and GrADS.

### ➤ **UCAR/Unidata/and DODS (URI/MIT):**

Unidata's "THematic Real-time Environmental Distributed Data Services (THREDDS)" system and the Distributed Oceanographic Data System (DODS) for access services.



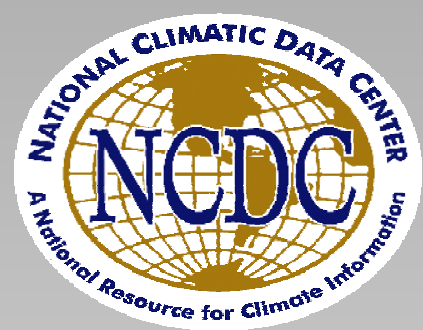
## NOMADS: *Software Development*

### ➤ **NCAR and DOE/LLNL:**

NOMADS is a partner with NCAR's Community Data Portal (CDP) project, and the DOE's Accelerated Climate Prediction Initiative (ACPI) project at LLNL.

### ➤ **NASA Global Change Master Directory:**

Through the GCMD, NASA is a partner in the distributed data sharing framework in NOMADS and is a potential software contributor.



# NOMADS: *Network Topology*

(DODS / GrADS/ Ferret, Gempak)

(GDS / LAS / Netscape / Excel)

User Downloads Data  
for Analysis with Local  
Tools

User Browses NOMADS  
Server Catalog and  
Analyzes Data with  
Server Tools

DLESE  
Digital Library for  
Earth-System Education

Application  
specific protocols

Web protocols for discovery

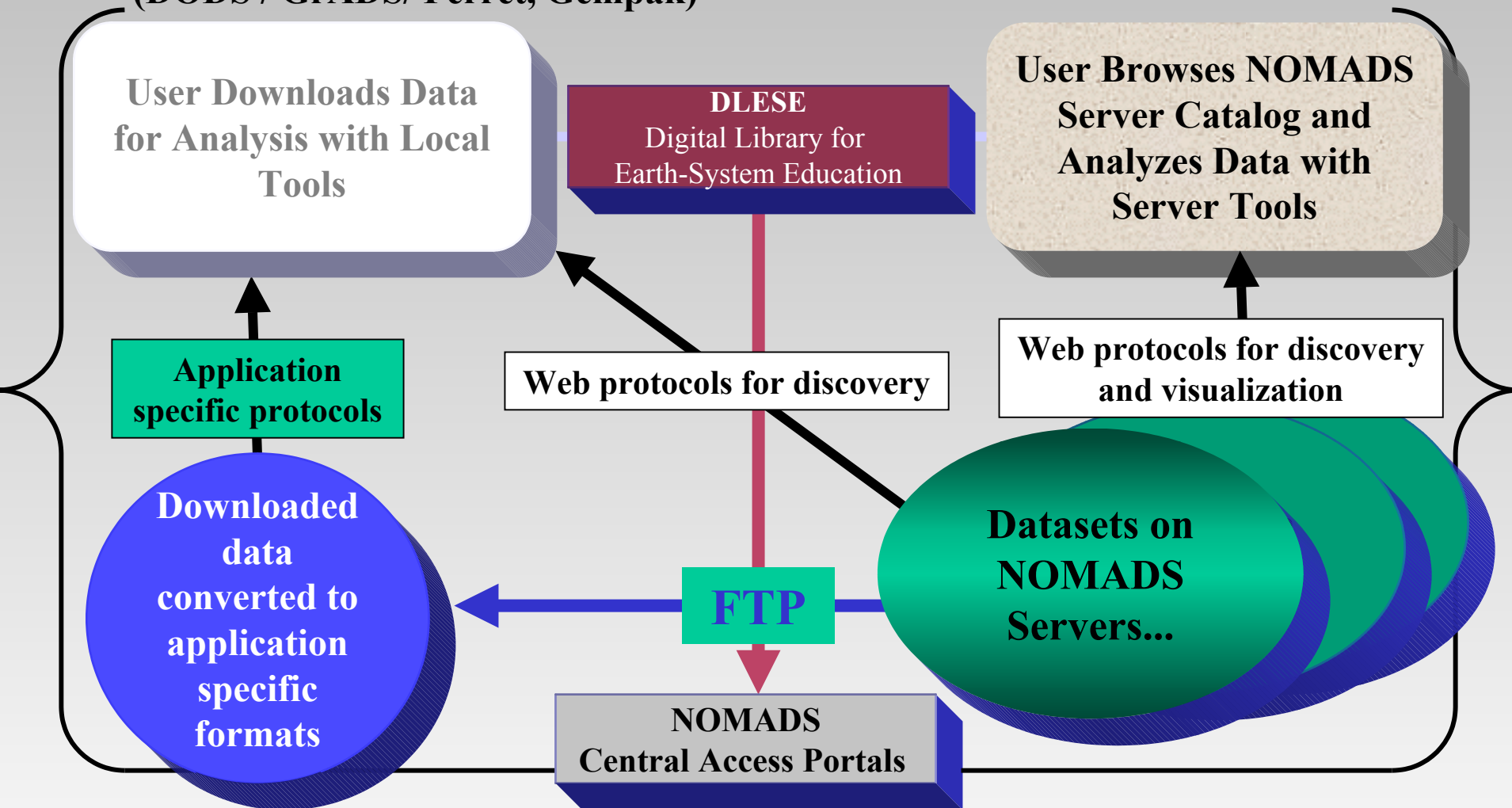
Web protocols for discovery  
and visualization

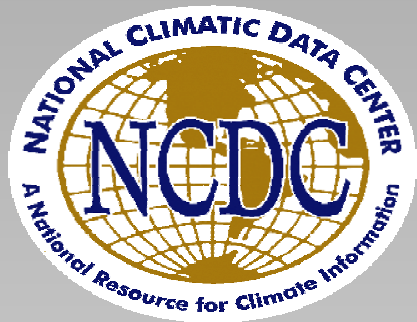
Downloaded  
data  
converted to  
application  
specific  
formats

Datasets on  
NOMADS  
Servers...

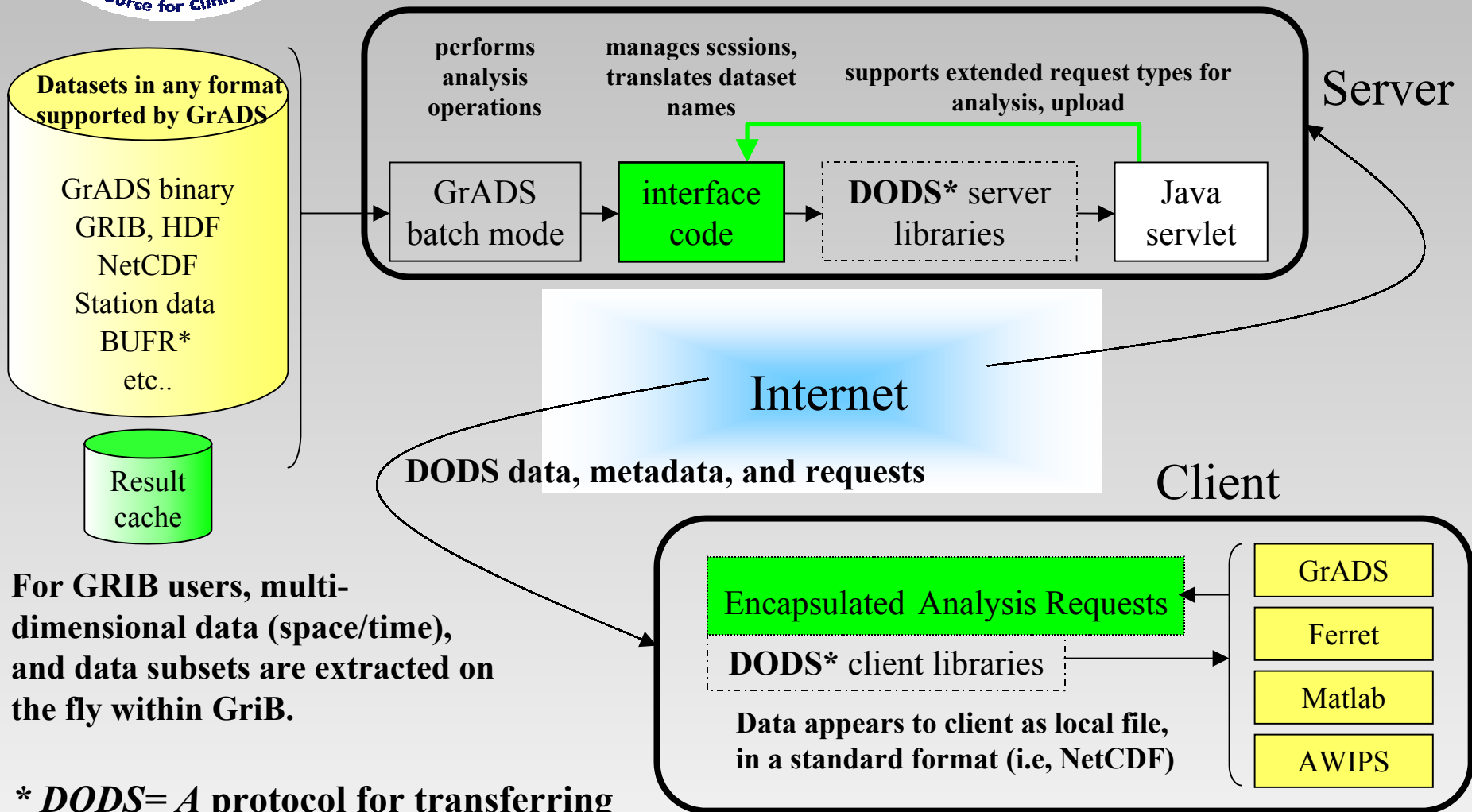
FTP

NOMADS  
Central Access Portals





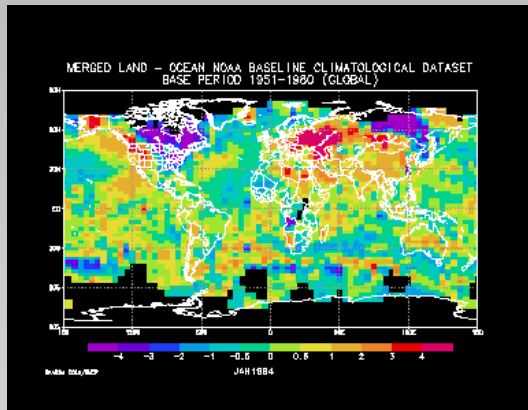
# NOMADS: *GrADS-DODS Server*



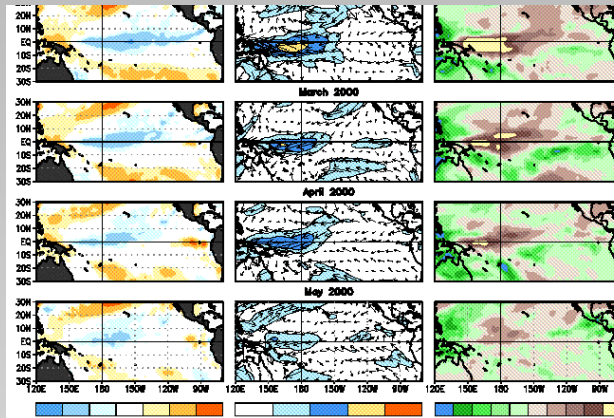
For GRIB users, multi-dimensional data (space/time), and data subsets are extracted on the fly within GriB.

\* *DODS*= A protocol for transferring data and metadata over the internet independent of file format

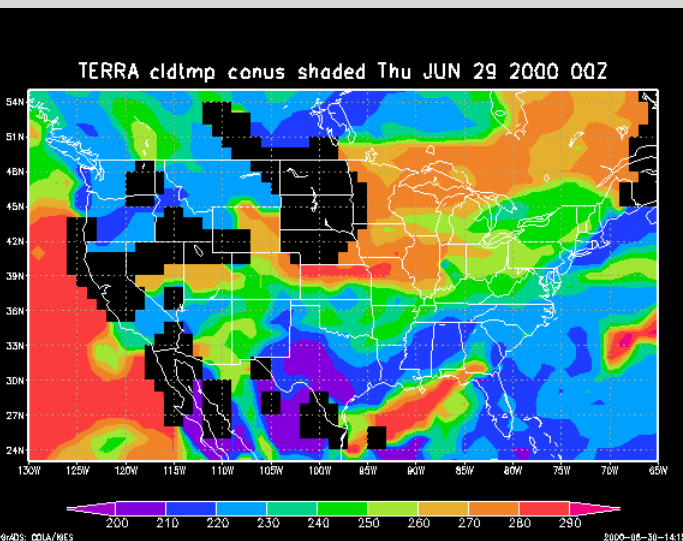
# Examples of NOMADS Used on the Web to Deliver Images



NCDC - <http://www.ncdc.noaa.gov/onlineprod/prod.html>

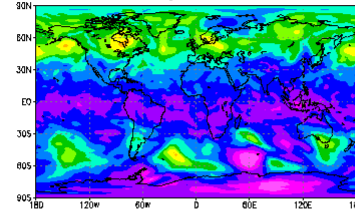


CPC - <http://www.cpc.ncep.noaa.gov/products/>

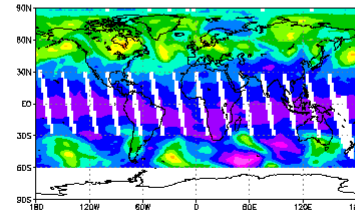


DOLMS - <http://dao.gsfc.nasa.gov/monitoring/>

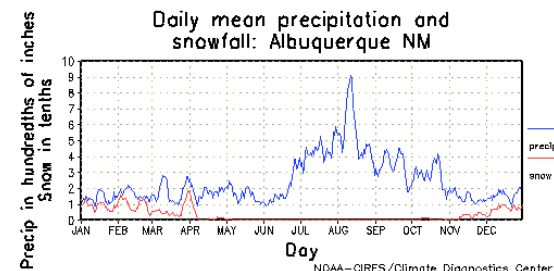
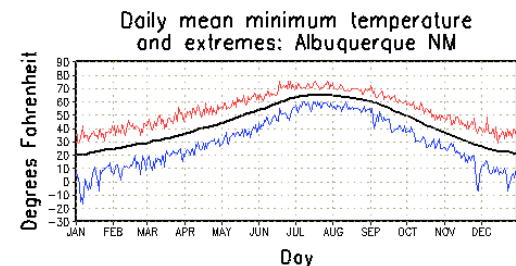
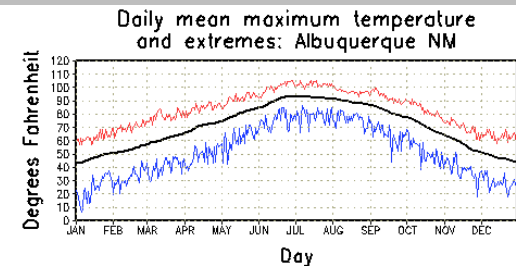
Total ozone analysis at 12Z28JUN2000



TOMS total ozone on 28JUN2000



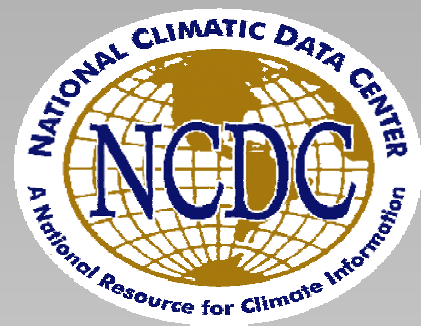
DOLMS Ozone - <http://dao.gsfc.nasa.gov/monitoring/>



CDC - <http://www.cdc.noaa.gov/USclimate/>

Sources:

- CDC
- NASA/DAO
- NCDC
- NCEP/CPC



## NOMADS: *DODS Clients/Servers*

DODS is a software framework that simplifies scientific data networking, allowing simple access to remote data.

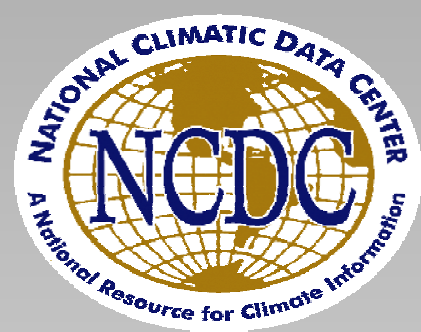
### ➤ **Data access (client)**

- Access to remote data in the users normal application
  - IDL
  - Matlab
  - Ferret
  - GrADS (GRIB thru GDS)
  - Any netCDF application
  - Netscape / Excel / etc.
  - AWIPS / Gempak
  - Don't need to know the data format in which the data is stored.

### ➤ **Data publishing (server)**

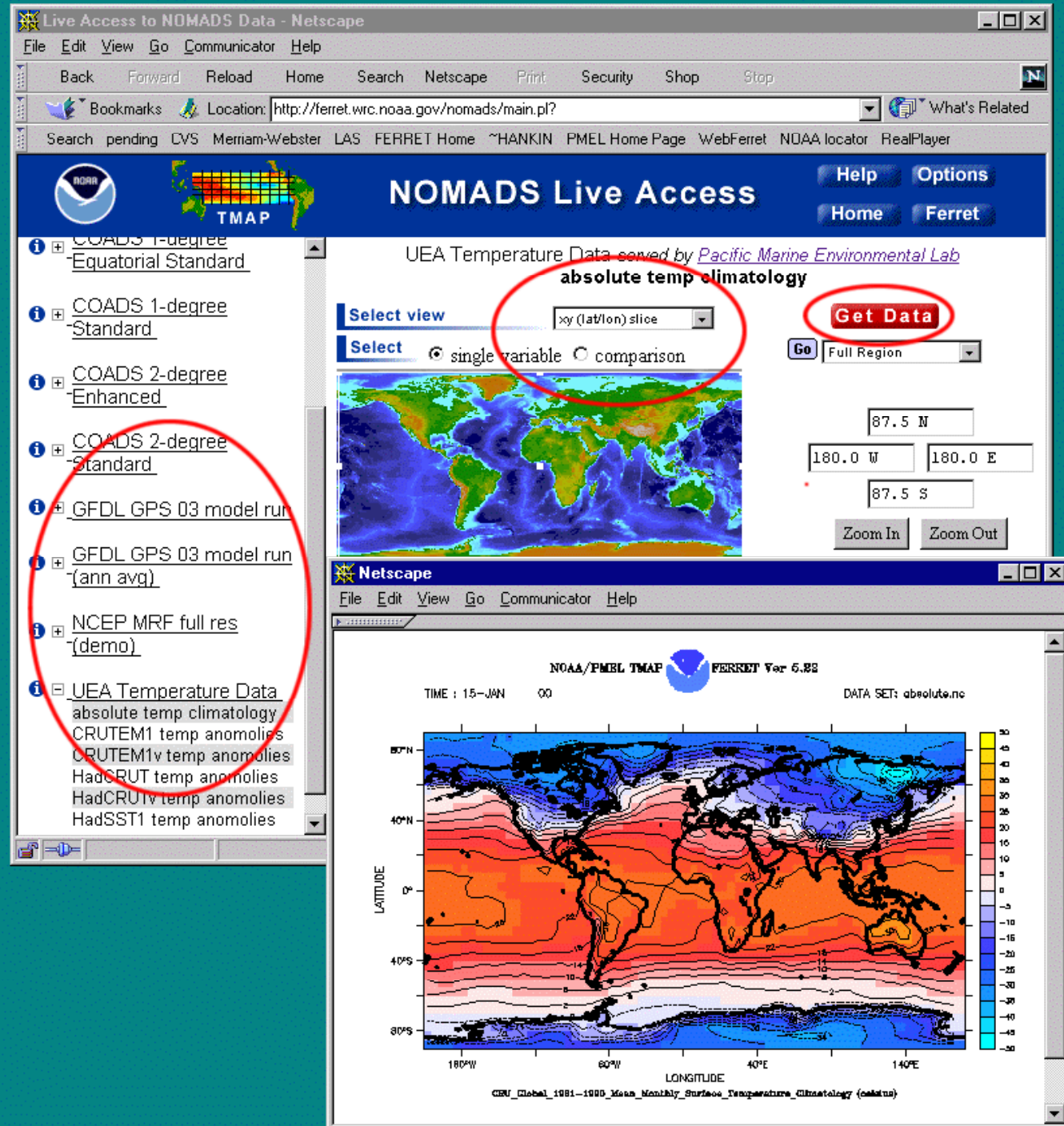
- Can serve data in various formats
  - netCDF
  - HDF
  - SQL
  - FreeForm
  - JGOFS
  - DSP
  - ascii
- Data subsetting.

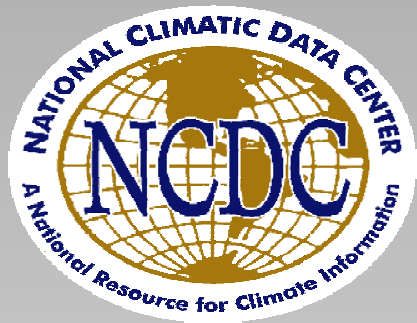




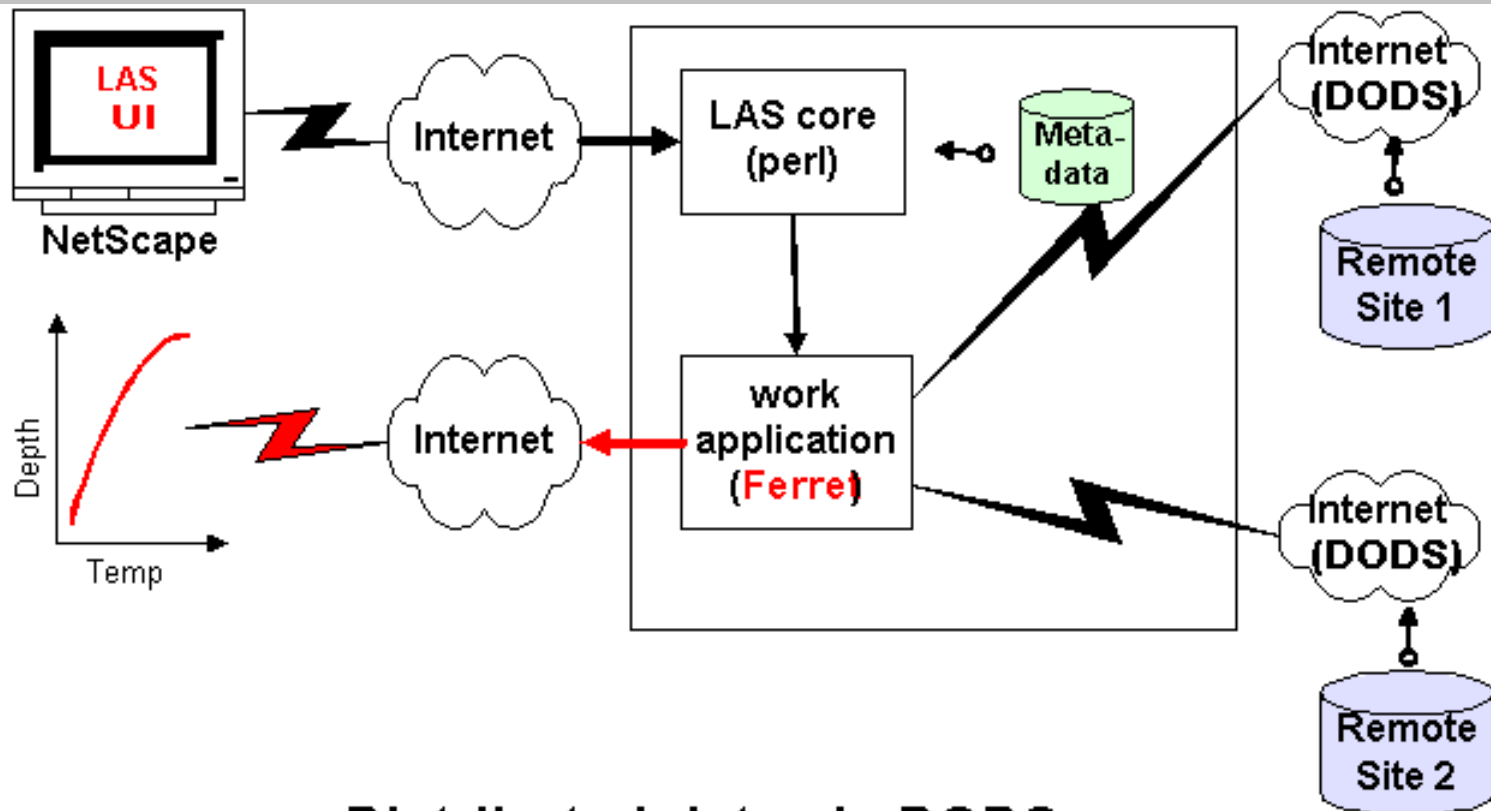
## NOMADS Live Access Server (LAS)

- Manipulate distributed data sources across the Internet
- Various analysis/views, time series, profiles, and output formats





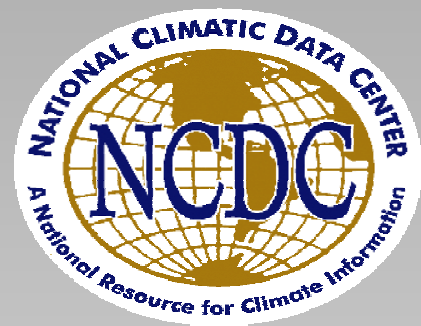
## NOMADS: *LAS and DODS*



**Distributed data via DODS**

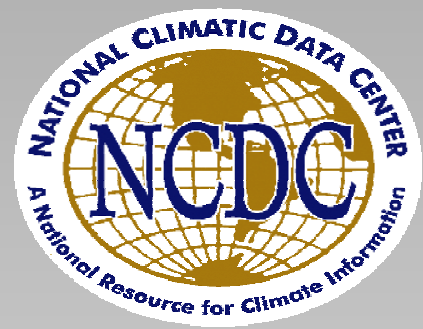
<http://tmap.pmel.noaa.gov/~hankin/AMS/jan02/LASforInsitu/>





## NOMADS: *Metadata Conventions*

- Federal Geographic Data Committee (FGDC); and Cooperative Ocean/Atmosphere Research Data Service (COARDS), a NOAA/university cooperative for the sharing and distribution of global atmospheric and oceanographic research data sets.
- NOMADS allows for expansion of other data forms (OpenGIS SOAP, ISO, NSDL) and Digital Library for Earth Science Education (DLESE) under the National Science Foundation.
- NOMADS is following an emerging template as developed by various communities such as DODS, NVODS, DLESE, and others in order to ensure compatibility across multiple organizations and multiple datasets.



## NOMADS: *Data Availability- CY02*

### ➤ **Climate-**

GFDL: Coupled Models, Control and Perturbation Integrations

NCAR: Community Climate Model / Reanalysis

NCDC: LTA for GFDL and NCEP models / Reanalysis 2

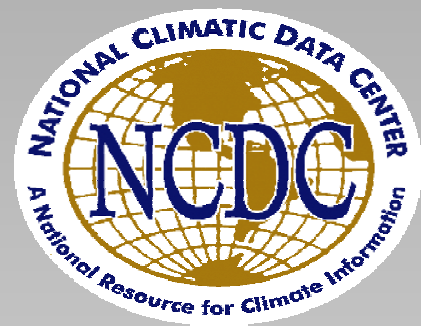
CDC: Climate / Ocean / Atmospheric / Reanalysis data sets

### ➤ **Weather-**

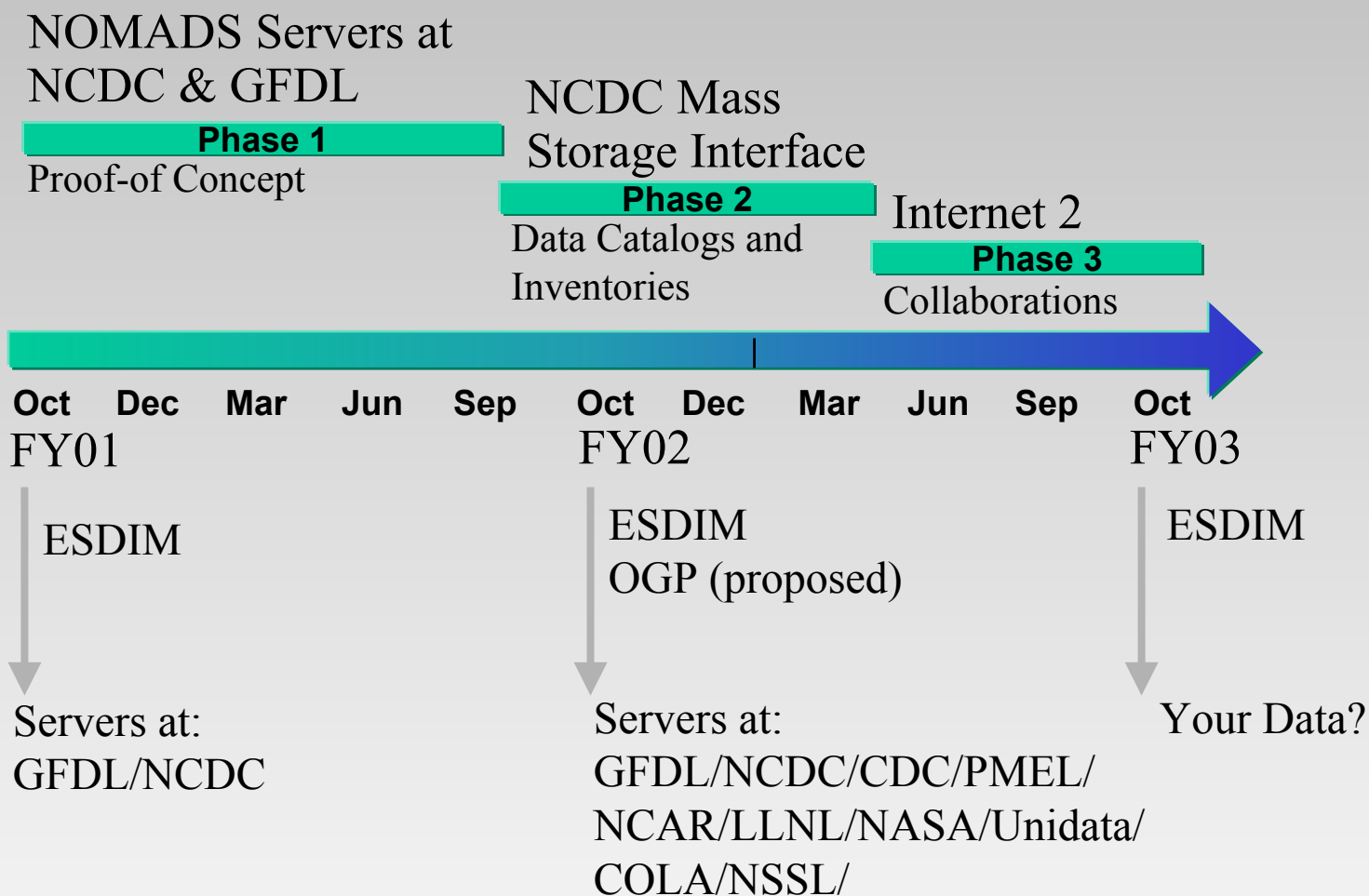
NCDC: Retrospective NOAA Port AWIPS Grids / NCEP  
global model data assimilation and restart files

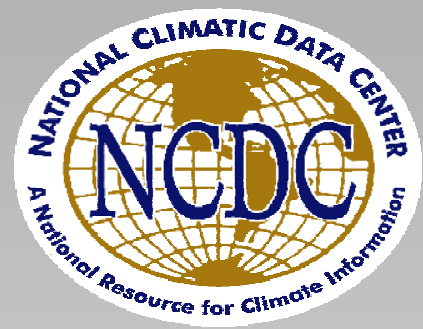
NCEP: Real-time NOMADS server

CDC: Atmospheric/Ocean/Reanalysis data sets



# NOMADS: *Schedule*





## NOMADS: *Data Access Portals*

CDC: <http://www.cdc.noaa.gov/cgi-bin/nph-nc/Datasets>

COLA: <http://cola8.iges.org:9090/dods>

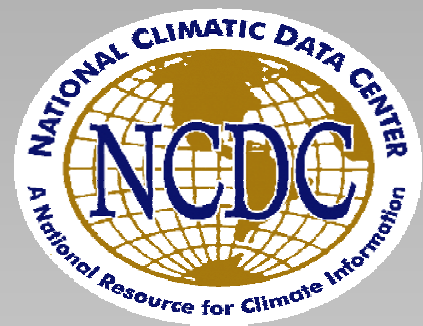
GFDL: <http://nomads.gfdl.noaa.gov/>

NASA: <http://gcmd.nasa.gov/Data/portals/dods/>

NCAR: <http://motherlode.ucar.edu:9091/>

NCDC: <http://ferret.wrc.noaa.gov/nomads/>

Unidata: <http://www.unidata.ucar.edu/>



## NOMADS: *Developmental Portals*

COLA:

<http://cola8.iges.org:9090/dods>

LLNL:

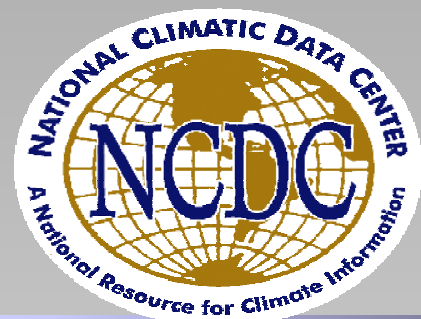
<http://www-pcmdi.llnl.gov/>

PMEL:

[http://ferret.wrc.noaa.gov/Ferret/LAS/LAS\\_servers.html](http://ferret.wrc.noaa.gov/Ferret/LAS/LAS_servers.html)

Unidata:

<http://www.unidata.ucar.edu/projects/THREDDS/>



## NOMADS: *Team Members*

FOR MORE INFORMATION...

<b>PI:</b>	<b>Glenn K. Rutledge*</b>	<b>NCDC (PI)</b>
<u><b>Discipline</b></u>		
<b>Climate:</b>	<u>Ron Stouffer</u> /Chris Kerr	GFDL
	<u>Steve Worley</u> /Don Middleton	NCAR
	<u>Dean Williams</u> /Mike Fiorino	LLNL/PCMDI
	<u>Scott Ritz</u> /Lola Olsen	NASA/GCMD
	<u>Don Hooper</u> /Donald Mock	CDC
<b>Weather:</b>	<u>Jordan Alpert</u>	NCEP
	Brian Doty/Menas Kafatos	COLA/GMU
	<u>Ben Domenico</u> /Ethan Davis	UCAR/Unidata
<b>Ocean:</b>	<u>Steve Hankin</u>	PMEL
	Dick Reynolds	NCDC

\* [Glenn.Rutledge@noaa.gov](mailto:Glenn.Rutledge@noaa.gov)